CLAIMS

1. A method of operating a solid oxide fuel cell stack to optimise an energy conversion efficiency of the stack, wherein the solid oxide fuel cell stack comprises mixed ionic/electronic conducting electrolytes, the method comprising:

determining the required power output of the solid oxide fuel cell stack; and

controlling one or more operating conditions of the solid oxide fuel cell stack dependent upon the determined power output to optimise said energy conversion efficiency during operation of the stack.

2. A method according to claim 1, wherein the operating conditions of the solid oxide fuel cell stack that are controlled are at least one of the temperature of the fuel cell stack and the dilution of fuel delivered to the fuel cell stack.

3. A method according to claim 2, wherein as the power output of the solid oxide fuel cell stack is reduced, the temperature of the fuel cell stack is reduced and as the power output of the solid oxide fuel cell is increased, the temperature of the fuel cell stack is increased.

4. A method according to claim 2 or claim 3, wherein the temperature of the fuel cell stack is maintained at 650°C or below.

5. A method according to claim 4, wherein the temperature of the fuel cell stack is maintained at 600°C or below.

6. A method according to any of claims 2 to 5, wherein the fuel delivered to the fuel cell stack is diluted with a predetermined amount of steam, carbon dioxide, nitrogen or a mixture including steam, carbon dioxide and/or nitrogen.

7. A method according to any of claims 2 to 5, wherein the fuel delivered to the fuel cell stack is diluted with a variable proportion of recycled exhaust gas from an anode side of the fuel cell.

8. A method according to any of claims 2 to 7, wherein as the power output of the solid oxide fuel cell stack is reduced, the dilution of the fuel delivered to the fuel cell stack is increased and as the power output of the solid oxide fuel cell is increased, the dilution of the fuel delivered to the fuel cell stack is reduced.

9. A method according to any of the preceding claims applied to a solid oxide fuel cell with an electrolyte including gadolinium-doped cerium oxide.

10. A method substantially as hereinbefore described with reference to the accompanying drawings.

11. A control system configured to optimise an energy conversion efficiency of a solid oxide fuel cell stack, wherein the solid oxide fuel cell stack comprises a mixed ionic/electronic conducting electrolyte, the control system comprising:

means for determining a required power output of the stack; and

a controller for controlling one or more operating conditions of the stack dependent upon the required power output to optimise said energy conversion efficiency during operation of the stack.

12. A control system according to claim 11, wherein the controller is arranged to control at least one of the temperature of the stack and the dilution of fuel delivered to the stack.

13. A control system according to claim 12, wherein the controller reduces the temperature of the stack as a result of the determining means determining that the required power output is reducing and the controller increases the temperature of the stack as a result of the determining means determining that the required power output is increasing.

14. A control system according to any one of claim 11 to 13, wherein the determining means monitors an electrical power output from the stack.

15. A control system according to any of claims 11 to 14, wherein the controller maintains the temperature of the stack at 650° or below.

16. A control system according to claim 15, wherein the controller maintains the temperature of the stack at 600°C or below.

17. A control system according to any one of claims 11 to 16, wherein the controller arranges the fuel delivered to the fuel cell stack to be diluted with a predetermined amount of steam, carbon dioxide, nitrogen or a mixture including steam, carbon dioxide and/or nitrogen.

18. A control system according to any one of claims 11 to 17, wherein the controller arranges the fuel delivered to the fuel cell stack to be diluted with a variable proportion of recycled exhaust gas from anode sides of the fuel cell stack.

19. A control system according to any one of claims 11 to 18, wherein the controller increases the dilution of the fuel delivered to the fuel cell stack as a result of the determining means determining that the required power output is reducing and the controller reducing the dilution of the fuel delivered to the fuel cell stack as a result of the determining means determining that the required power output is increasing.

20. A control system substantially as hereinbefore described with reference to the accompanying drawings.

21. A fuel cell stack with mixed ionic/electronic conducting electrolytes including a control system according to any one of claims 11 to 20.

22. A fuel cell stack substantially as hereinbefore described with reference to the accompanying drawings.